

## **1.0 INTRODUCTION**

In 1993, the United States Environmental Protection Agency (EPA) - New England (Region 1) and United Technologies Corporation (UTC) lodged a consent decree with the United States District Court for the District of Connecticut, settling a multimedia enforcement action that involved 10 of UTC's facilities in New England. Under the terms of the settlement, UTC agreed to develop and implement environmental management systems (EMS) in all its facilities in New England (originally 26 facilities, currently 18, including facilities of Hamilton Sundstrand Division, Pratt & Whitney Division, Sikorsky Aircraft Division, and UT Research Division). The settlement required that UTC hire a management consulting firm to perform an EMS analysis and prepare a report of recommendations to correct practices that adversely affected the company's ability to achieve compliance. The settlement also required that UTC hire an audit firm to conduct independent, third-party compliance audits of UTC facilities once changes in the management systems had been implemented.

After a six-month period for implementing the recommendations in the Management Systems Improvement Plan that began in 1996, a work plan was developed for the performance of third party compliance audits. In 1997 and 1998, the third-party compliance audits required under the consent decree were performed and, as required, the results were reported to EPA New England. On the basis of the audit reports, EPA New England issued its Report of Violations in 1999. The existence of both information about noncompliance with requirements under the Resource Conservation and Recovery Act (RCRA) and the Clean Water Act (CWA) for eight of the existing facilities (from inspections) from the period before implementation of the EMSs, and compliance information from the period after implementation of the EMSs (from the third-party compliance audits) provided a rare opportunity to review the effect on compliance at UTC facilities of implementing the management systems analysis and improvements in the EMS.

Through this study, EPA and UTC seek to understand the causes of noncompliance and the relationship between environmental performance and the existence and level of implementation

of an EMS at the facility level. In support of that objective, EPA, with the assistance of its contractor, Tetra Tech EM Inc. (Tetra Tech), and in conjunction with UTC, developed three types of survey designed to obtain information that would allow them to:

- Determine the effect that implementation of an EMS has on compliance
- Identify or evaluate differences in root causes of noncompliance before and after implementation of an EMS at a facility
- Identify or evaluate differences in pollution prevention practices before and after implementation of an EMS at a facility

The three types of survey are: (1) facility-specific pre-EMS surveys, (2) facility-specific post-EMS surveys, and (3) a corporate EMS survey.

This EMS implementation study, conducted by EPA - New England and UTC, incorporated the concepts developed under a previous root cause analysis conducted by EPA and the Chemical Manufacturers Association (CMA) (the EPA/CMA Root Cause Analysis Pilot Project [EPA-305-R-99-301], herein referred to as the RCA project). EPA and CMA developed a root cause analysis survey designed to achieve the first two of the three objectives stated above. EPA and UTC modified the survey developed under the EPA/CMA project to make it more relevant to UTC policies and operations and to include an evaluation of pollution prevention (P2) practices at UTC facilities.

Of the facilities that were inspected or reviewed and included in the 1993 complaint, eight have continued in operation; UTC personnel representing those eight facilities participated in the pre- and post-EMS surveys. The surveys were designed to (1) obtain general information about each facility; (2) characterize instances of noncompliance into noncompliance categories, as defined by the survey; (3) identify root and contributing causes of noncompliance; (4) identify responses to the noncompliance; (5) identify the elements of an EMS (as defined by the pre- and post-EMS surveys) in place at each facility in 1990 and 1998; and (6) identify P2 practices in use at each facility before and after implementation of an EMS. In addition, UTC completed a corporate

EMS survey that requested information about EMS and P2 policies at the corporate level as of 1990 and solicited UTC's suggestions about approaches to compliance assistance or regulatory reforms that might improve compliance at UTC facilities. Before the surveys were completed, Tetra Tech developed regulatory compliance profiles for participating facilities. The information in these profiles is based on the results of inspections and records reviews conducted by EPA and state regulators before 1990 (pre-EMS profiles). UTC developed regulatory compliance profiles based on the results of third-party audits performed in 1997 and 1998 (post-EMS profiles).

Respondents characterized violations identified in the complaint as noncompliance events, classifying each under 1 of 15 noncompliance categories provided and according to the statute under which the noncompliance event occurred. The 15 noncompliance categories defined in the survey are listed below.

Noncompliance Categories	
<ul style="list-style-type: none"> <li>• Corrective Action Activities</li> <li>• Equipment/Unit Design</li> <li>• Exceedance</li> <li>• Failure to Respond</li> <li>• Labeling</li> <li>• Legal Agreement</li> <li>• Monitoring/Detection/Control</li> <li>• Operations and Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Record Keeping</li> <li>• Report Submissions and Reporting</li> <li>• Spills/Releases</li> <li>• Testing</li> <li>• Training/Certification</li> <li>• Unpermitted/Unauthorized Activity</li> <li>• Waste Identification</li> </ul>

Survey respondents were provided the following definitions of the terms **root cause** and **contributing cause**.

- **Root cause:** A primary factor that led to the noncompliance event
- **Contributing cause:** A secondary factor that led to the noncompliance event

The survey identified 12 general **categories** of causes. Those categories are listed below.

Categories of Root and Contributing Causes	
<ul style="list-style-type: none"><li>• Human error</li><li>• Policies</li><li>• Procedures</li><li>• Management</li><li>• Training</li><li>• Communication</li></ul>	<ul style="list-style-type: none"><li>• Emergency procedures</li><li>• Process upset or failure</li><li>• Compliance monitoring</li><li>• Regulations and permits</li><li>• External circumstances</li><li>• Equipment problems</li></ul>

Each general **category** then was subdivided resulting in a total of 74 *specific* causes. An “Other” category also was provided for cases in which the predefined **categories** did not describe adequately the root or contributing cause(s) of a noncompliance event. Respondents were asked to select no more than three root causes from among the 74 *specific* causes and to select any number of contributing causes to characterize the noncompliance event. To facilitate completion of the survey, respondents were directed to address similar noncompliance events as a single event. For example, if a facility had a number of noncompliance events related to reporting requirements the facility would consider all those occurrences as a single event.

This report presents an analysis of (1) responses to the EMS surveys prepared by UTC facilities participating in the EPA New England EMS implementation study and (2) regulatory compliance profiles that Tetra Tech and UTC developed for participating UTC facilities. The remainder of this document consists of nine sections, as follows:

- Section 2.0, Overview of UTC Facilities Included in the Survey
- Section 3.0, Elements of the EMS at Each UTC Facility
- Section 4.0, Presentation of UTC’s Compliance Status and the Root and Contributing Causes of Noncompliance in 1990 and in 1998
- Section 5.0, Effect of the Implementation of an EMS on the Root Causes of Noncompliance

- Section 6.0, Effect of the Implementation of an EMS on Compliance
- Section 7.0, P2 Practices at UTC Facilities
- Section 8.0, UTC's Recommendations for Compliance Assistance
- Section 9.0, Comparison to EPA/CMA Root Cause Project Results
- Section 10.0, Conclusions

## 2.0 OVERVIEW OF UTC FACILITIES INCLUDED IN THE SURVEY

The pre- and post-EMS surveys asked for general information about the operations conducted at each of the eight facilities, the number of employees at each facility, and other general information about each facility. Table 1 presents a summary of the information gathered through the post-EMS surveys (representing information about conditions at the facilities during 1998).

**TABLE 1**  
**PROFILE OF UTC FACILITIES**

	<b>Hamilton Sundstrand Windsor Locks</b>	<b>Pratt &amp; Whitney Colt Street</b>	<b>Pratt &amp; Whitney East Hartford</b>	<b>Pratt &amp; Whitney Middletown</b>	<b>Pratt &amp; Whitney North Haven</b>	<b>Pratt &amp; Whitney Rocky Hill</b>	<b>Sikorsky Stratford</b>	<b>UT Research Center</b>
Primary SIC Code	3728	3724	3724	3724	3724	3724	3724	8731
Number of Employees								
- Full-time	>500	10-49	>500	>500	>500	50-100	>500	>500
- Contractors	101-500	0-9	>500	101-500	10-49	0-9	>500	10-49
Job Responsibility of Person Completing Survey	Compliance staff	Compliance staff	Compliance staff	Compliance staff/ environmental engineer/ plant management	Plant management/ environmental engineer	Compliance staff/ environmental engineer	Plant management/ environmental engineer	Compliance staff
Activities Currently Performed at the Facility	Aerospace manufacturing	Design, manufacture, testing, overhaul of jet engines	Design, manufacture, testing, overhaul of jet engines	Manufacture, assembly, testing of aircraft engines	Design, manufacture, testing, overhaul of jet engines	Production of composite aircraft engine parts	Manufacture and assembly of helicopters and helicopter parts	Research (unspecified)
Years in Operation	>10	>10	>10	>10	>10	>10	>10	>10